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NASA TECHNICAL TRANSLATION

NASA TT F-16745

DURABILITY OF TUNGSTEN-COBALT CARBIDE ALLOYS

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(NASA-TT-F-16745) DURABILITY OF
TUNGSTEN-COBALT CARBIDE ALLOYS (Scientific
Translation Service) 6 p HC \$3.50 CSCL 11D

N76-28369

G3/24

Unclas
47957

Translation of "Iznosostoykost' splavov karbid
vol'frama-kobalt'", Mashinovedeniye, No. 1, 1974,
pp. 111-112.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

JULY 1976

DTIC QUALITY INSPECTED 4

N76-28369
MMCIAC
000200

STANDARD TITLE PAGE

1. Report No. NASA TT F-16745	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle DURABILITY OF TUNGSTEN-COBALT CARBIDE ALLOYS		5. Report Date July 1976	6. Performing Organization Code
		8. Performing Organization Report No.	10. Work Unit No.
7. Author(s) P. D. Shnyrev		11. Contract or Grant No. NAS7-100	
		13. Type of Report and Period Covered Translation	
9. Performing Organization Name and Address SCITRAN P. O. Box 5456 Santa Barbara, CA 93108		14. Sponsoring Agency Code	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D. C. 20546			
15. Supplementary Notes Translation of "Iznosostoykost' splavov karbid vol'frama-kobalt'", Mashinovedeniye, No. 1, 1974, pp. 111-112.			
16. Abstract			
17. Key Words (Selected by Author(s))		18. Distribution Statement Unclassified - Unlimited	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages	22. Price

GK-639832

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1974, pp. 111-112.

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Prepared for and issued by the Jet Propulsion Laboratory
California Institute of Technology, Pasadena, Calif.
Under NASA contract NAS 7-100
February 1976

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The productivity, reliability, and life of machines and mechanisms depend on the durability of the materials. The wear of materials is determined by several interrelated parameters of the composition, structure and the mechanical properties of the alloys which come in contact during friction. The results of studying the wear of solid alloys of tungsten-cobalt carbides in a medium of liquid nitrogen are described in the study [2]. These results give an indication of the interrelationship between the magnitude of wear and their mechanical properties (hardness).

This article discusses the relative durability of alloys previously studied [2] with a differing content of cobalt and a different average grain diameter of the tungsten carbide. In the former case, the cobalt content in the alloys changed from 4 to 20%. In the latter case, tests were conducted on alloys with 6% cobalt of very fine grained, fine, normal, and large grained series (VK60M, VK6M, VK6, VK6B), with grain diameters of the carbide phase of 1.27; 2.0; 2.35 and 2.54 μ respectively. The wear was determined in the form of volumetric wear, and the relative durability was determined as the ratio of the standard wear magnitude to the wear of the sample being studied with the same friction methods. The alloy VK6 was used as the standard.

*Numbers in the margin indicate original pagination of foreign text.

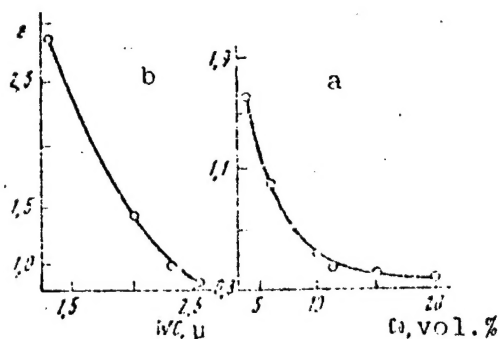


Figure 1. Relative durability of WC-Co alloys of differing composition (a). Relative durability of VK6 alloys with different average dimensions of the tungsten carbide grains (b).

Figure 1,a presents a diagram showing the dependence of the relative durability of solid alloys on the cobalt content. The relative durability decreases with an increase in the cobalt content in the alloys (within the limits of the experiment) approximately according to an exponential law $\epsilon = \epsilon_0 e^{-k'x}$, where k is the constant, and x is the volumetric content of cobalt.

The studies performed show that in the case of friction in a medium of liquid nitrogen the durability of the solid alloys depends greatly on their composition. Qualitatively similar results were obtained in study [1] in the case of abrasive wear of tungsten solid alloys in a medium of air. Thus, data on the durability of alloys of differing compositions reflect the principles governing abrasive wear of solid alloys. /112

Figure 1,b gives a diagram showing the results of experiments which investigated the influence upon durability of average dimensions of the grains of tungsten carbide. The durability decreased with an increase in the average grain dimensions of the carbide phase in the range of grain dimensions investigated, 1.27-2.54 microns. The data obtained show that the structure, particularly the average dimensions of grains of the carbide phase, has a great influence upon the durability of tungsten-cobalt carbide alloys, along with the content of cobalt (Figure 1,a). Based on these data, it may be concluded that the ability of fine-grained alloys to resist wear in the case of low temperature friction is higher than that of large grained alloys. Thus, it may be seen

from the diagram in Figure 1,b that a two-fold increase in the grain size (from 1.27 to 2.54 microns) leads to a three-fold reduction in the magnitude of the alloy durability (under the given friction conditions).

It has been established as a result of this study that the durability of solid alloys in a medium of liquid nitrogen depends essentially both on the composition of the solid alloys of the tungsten-cobalt carbides as well as on the dimensions of the carbide phase grains in the VK6 alloy.

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